Creation of a Software Application for the Clinical Radiologist

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Purpose: To create a software application that automates a significant portion of a clinical radiologist's work. **Methods:** The daily workflow of clinical radiologists in a university-based department was analyzed, specifically looking for manual tasks that could be implemented in software. An application that a practicing radiologist would use in his daily work was created. **Results:** By using speech recognition, reports could be created, edited, and verified immediately. Online medical reference information could be made instantly accessible. Billing data could be captured accurately and completely at report creation time. A radiologist could be alerted to important upcoming events by use of a reminder system. Reports could be delivered immediately to referring physicians using either the internet or telephone. **Conclusions:** It is possible to improve the productivity of busy practicing clinical radiologists by automating a large portion of their workflow and implementing it in an easily mastered software application.

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WE SET OUT TO CREATE a software application that automates a significant portion of the daily workflow of a clinical radiologist and that can both improve his/her productivity and be simple to use.

BACKGROUND

Physicians in general are reluctant to use personal computers in their daily clinical work. Two common reasons for this are an unwillingness to change the way they practice and because of a fear that they will be slowed down by needing to follow a regimented data input process. Radiologists fall into this category as well. However, many of this group have already begun to use computers in their departments, frequently to review and correct transcribed reports and, more recently, to view images on picture archiving and communication system (PACS) workstations.

Many functions that a radiologist performs are repetitive (eg, dictating the same phrases over and over) and therefore tedious. As well, many currently manually performed functions (eg, completing billing forms) can now be automated using a computer. It was therefore anticipated that a computer program could be developed that would be attractive to radiologists.

Major advances in computer technology, both hardware and software, have been made in recent years and continue at a rapid pace.^{1,2} We therefore

undertook to create a software application, using state-of-the-art computer technology, that automates many of the radiologist's work processes.

METHODS

The daily workflow of clinical radiologists in a busy university-based department was analyzed, specifically looking for manual tasks that could be implemented in software. Using state-of-the-art technologies, including internet tools and speech recognition, an application that a practicing radiologist would use in his daily work was created.

A list of specific tasks that are done in the day-to-day work of a clinical radiologist was compiled and 20 staff radiologists in a busy clinical medical imaging department of a large teaching hospital were interviewed. In each of 12 areas of the department, staff were asked how frequently (times per day) they performed each of the tasks, and how long it took to perform them. Using these data, as well as considering how difficult it was to implement the specific task in software, a decision was made as to which tasks should be included in the application. Two fundamental principles in the design of the system were that it must not slow the radiologist down and it must be intuitive to use.³

A decision was made to create the application to run in a web browser because users were becoming quite familiar with this user interface style and because of the very significant advantages it provided in system design, including data access from legacy systems. As prototypes were developed, extensive feedback was provided by radiologists and their requirements were included in future versions.

RESULTS

A number of manual functions that could be automated were discovered: report creation, editing, and signoff could be completed immediately using speech recognition; and medical reference information could be placed online for instant access. Simple forms could be displayed allowing for easy collection of data required for quality assurance and utilization management reports. By creating a large database of medically relevant information and interfacing with the radiology information system (RIS), billing data could be cap-

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0897-1889/01/1402-1054\$35.00/0

doi:10.1053/jdim.2001.23871

tured accurately, rapidly, and completely at report creation time. A reminder system could alert the radiologist to important upcoming events. Using the internet and telephone systems, reports could be delivered immediately to referring physicians. Events performed by the system could be permanently stored for future analysis, including productivity reports and audit trails for medical-legal issues. Access could be provided to the daily duty roster and to vacation schedules.

The speech recognition component proved to be the most challenging to design and required the most flexibility for user satisfaction. The user interface could be very rich in design and provide access to a large number of functions because of the user's rapid familiarity with how these function were accessed. The fact that it made certain manual functions much simpler to perform made the radiologist more likely to perform them, potentially improving patient care. The system could be easily interfaced with a PACS workstation.

CONCLUSION

By paying close attention to how radiologists do their work, including the micro details of each workstep, it was possible to design and create a system that they both find very useful and enjoy using. It was necessary to have access to radiologists willing to spend time discussing their needs and how they work and able to express how the actual application should look and perform. With appropriate resources (human and technical), it is possible to design clinical systems for radiologists that they willingly accept.

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